

# **Vermont Farm Methane Project Quarterly Report**

**Prepared by: Jeffrey W. Forward, Project Coordinator January 15, 2001**

## **Introduction:**

The Vermont Department of Public Service (DPS) and the Vermont Department of Agriculture (AGR) received a \$300,000 appropriation from the FY 2000 federal budget to promote the use of methane recovery technology on Vermont dairy farms. This technology has the potential to help farmers with their nutrient management plans and at the same time provide additional on-farm income. The goal of this project is to identify and help overcome key strategic hurdles to widespread adoption of methane recovery technologies by Vermont farmers.

The project was designed to consider methane recovery in a broad context, taking into account its potential benefits as a component of a comprehensive nutrient management system, as a renewable energy source and as a strategy for greenhouse gas reduction.

Unfortunately there continue to be delays on completing the modifications we have been making to our research and development site at Foster Bros. Farm. The problem this quarter has been the bag covering the digester. This bag is made from landfill liner material. It has developed leaks in several places along the seal, in the corners, where it is attached to the concrete walls of the digester. This is a manufacturer's problem but since this bag is such a small item for them, they have not been very responsive about repairing the damage. We expect to have this problem repaired soon, but the material is very difficult to work with in cold weather and we are somewhat dependent on the availability of the bag manufacturer.

On the plus side Fosters was finally able to begin loading the digester with manure in September. Early indications are that the innovation of using steam heat to preheat the incoming manure seems to be working. Fosters was able to get the digester to produce gas in two weeks rather than the two months it took using the old system. This was very encouraging. We look forward to continuing with our research as soon as the bag is repaired.

Outreach activities have included working with two outside studies that are attempting to quantify the renewable resource potential for electrical generation in Vermont. One study intends to map potential methane producing sites and compare that with the electrical transmission and distribution grid in Vermont. The other is presenting the Vermont Methane Project as a case study of how to promote the use of a renewable fuel in a state.

Finally, with the help of Senator Jeffords, the Vermont Methane project has secured Phase II funding through another budget appropriation. The project has received \$395,000 and is developing a 3 year project implementation plan for this money. The plan calls for using one

third of the money for project administration and outreach, one third toward research and development and one third to be used for cost share for installations.

## **PROJECT ACTIVITIES October 1, 2000 - December 31, 2000**

**Foster Bros. Dairy Farm research and demonstration site:** Foster Bros. have a two chambered side-by-side digester that they have been using successfully for over 15 years. The Vermont Methane Project has isolated these into two separate digesters so that we can experiment with various materials and technologies and still maintain a control that we know works. Weather, delays in obtaining materials and the difficulty of scheduling plumbers and electricians has slowed construction and pushed back start-up dates. We have now encountered difficulties with patching leaks in the bag. Never-the-less the Fosters are now loading the digester and we hope to have it fully operational soon. We will then develop protocols and experiments to test a variety of theories on this research site. Our goal is to develop techniques and technologies that will speed digestion and reduce maintenance thereby making methane digestion more affordable for a variety of farm sizes and management styles.

One of the technological barriers to previous digester designs was the fact that if the heating pipes were too hot, manure would cake on to them. This tended to insulate the pipes and reduce their efficiency significantly. To avoid this problem, the digester needed to be heated slowly sometimes taking as long as two to three months to get the system up to temperature. We are experimenting with preheating the incoming manure with steam injection and early indications are that it appears to speed this process up considerably. We are able to put much more heat to the incoming manure without fear of caking. It now appears that we were able to bring the digester up to temperature in two to three weeks when previously it took two to three months. We will watch the developments closely over the next quarter. ( See attached report on digester observations)

**Feasibility Studies:** Jeff Forward and Dan Scruton have contacted 17 farms that have expressed interest in this project. The project managers visited 13 of those and have completed several pre-feasibility studies. The remaining reports are being finalized and will be sent to farmers shortly. A sample copy of one report was attached to a previous quarterly report.

We have come to some interesting conclusions from our initial feasibility studies. Based on the high initial capital cost of anaerobic digestion, the reduced electrical demand of many dairy farms due to utility conservation programs and the low price paid for wholesale electricity, it is difficult to find a situation that has a positive cash flow strictly on electrical benefits. Nutrient management will likely be the driving force in the decision making for most farmers. We may have some special cases, but currently the typical farmer who will be interested in pursuing this technology will likely be someone who has a relatively large herd, one who is sophisticated enough to want to take on a new technology and one who is interested in managing his nutrient loads. Odor control will also likely be a contributing factor.

**Site Specific Engineering Studies:** The project has identified at least several farms that warrant investing in site specific engineering analysis. We are proceeding cautiously with these site specific engineering studies because we want to incorporate our findings from the Foster's Bros. research into individual designs. We have begun designing a system for a 800 cow farm in Addison County and

want to investigate a series of options for this site. One option may be to size the anaerobic digester system based on the farm's electrical load rather than on the volume of manure produced. Under this scenario, a digester could be sized to meet the farm demand and the farm could then take advantage of the net metering option. This would allow the farm to build a smaller digester, reducing initial capital costs and it would permit them to generate virtually 100% of their electrical needs. This is an interesting possibility that we will pursue as we work through design options for this site.

**Attached Growth Media Experiments:** The project hired Steven Hoyt from Dubara Company to perform experiments on attached growth media in an attempt to speed the production of biogas and thereby reduce the retention time of manure in an anaerobic digester. The premise of this research is that reduced retention time of manure in a digester will allow engineers to design smaller digester and thereby reduce capital costs. Mr. Hoyt completed his research and his final report is on file.

Mr. Hoyt had one unexpected result from his research. His prototype experimental facility consisted of three 55 gallon drums, each drum essentially a mini digester, that he loaded with fresh manure from a near-by dairy farm. He set his experimental facility up right next to this farm's manure storage lagoon and when he was done with each batch, he dumped the digested material right into lagoon. Prior to the experiment, the manure in the lagoon typically had a thick crust of solids and produced very strong odors when spread. After more than a month of operating the experiment, there was a noticeable change in the consistency of the stored manure to a black very liquidy substance and a black bubbly foam formed on the surface as large amounts of gas bubbled off continuously. In addition, it was observed that when spread, there was not the usual strong offensive odors. Instead a rich ammonia-like smell was reported which dissipated quickly during spreading. Since the pilot project has ended, the stored manure in this pit has returned to its previous characteristics.

This unexpected result may warrant further investigation. One experiment we are considering is to take a load of digested manure from Fosters and inoculating one or more manure lagoons on nearby farms to see if there is any noticeable odor reduction. Odor control is a significant driver in farmers decisions to install methane recovery systems. If we can find a new use for the material coming out of an anaerobic digester, this may provide added value to the farmer who owns the digester.

**Methane Resource Assessment:** The project hired Jeff Fehrs to research the volume of available organic wastes in Vermont that could be digested to produce methane. The goal of this research is to determine the energy potential of these various waste streams. These organic wastes include manure, biosolids and septage, industrial food waste and whey. Mr. Fehrs research is complete and his report has been reviewed by the advisory committee and published by the DPS.

This report concludes that there is approximately 30 MW of capacity from digesting available organic material produced in Vermont and that dairy manure is by far the largest available source making up 94% of that 30 MW. Trucking other materials to an on-farm digester appears to be cost-effective in only limited circumstances. This resource assessment was attached to a previous quarterly report.

**Net Metering:** Net metering is a concept whereby a customer may generate electricity and send it on to "the grid" or alternatively use electricity by buying it from the grid. The monthly bill is then

calculated using the “net” of these two amounts. The Public Service Board (PSB) had been instructed to draft rules for this concept by the legislature. The DPS along with a number of parties to the docket have been providing technical recommendations. The PSB issued a board order approving requirements for interconnection for farm methane net metering facilities.

It may be that this concept will only work in limited circumstances. One limiting factor in net metering is that any excess electricity produced is permitted to offset on-site consumption, but only down to zero. Any excess does not have to be bought by the utility. This means that the methane production on a farm where this will work will necessarily need to be closely matched with their energy demand. Since the capital cost of a digester is significant, a farm will need a relatively large electrical load in order to offset that investment. It will also need to have enough animals to produce the right amount of biogas. It appears that farms with a large enough load to justify a methane recover facility produce more biogas than they would need for their normal energy needs.

One aspect we have been exploring is sizing a digester to produce just enough gas to meet the on-site electrical demand and treating the rest conventionally. This would reduce capital costs while at the same time capture the majority of benefits by offsetting the farmer’s retail electric costs. We will examine this approach as we design on-site systems.

#### **Outreach:**

**Phase II Funding:** With the help of Senator Jeffords, the Vermont Methane Project has secured another \$395,000 to fund Phase II of the project. The Executive Committee will meet in January, 2001 to prepare a workplan and discuss how to allocate those funds. Phase I monies totaling \$300,000 have been allocated in three roughly equal portions, one-third for administration and outreach, one-third for research and development and one-third reserved for cost share for installing systems. It is expected that Phase II monies will be allocated in a similar fashion.

**Wind and Biomass Penetration Study:** Princeton Energy Resources International from Rockville, MD is conducting a study to evaluate the effects of high penetrations of renewable energy on the Vermont electrical grid. The study is funded by DOE, the Vermont Department of Public Service and Green Mountain Power with support from Hyrdo-Quebec, E/PRO Engineering and Environmental Consulting, LLC and Vermont Environmental Research Associates, Inc. The Vermont Methane Project has cooperated with the research team and hopes to be able to use the results of this study to help identify potential farm methane recovery sites. If the utility is able to pay for the added value of renewable generation in a stressed transmission and distribution area, the economic feasibility of installing a methane recovery facility could change significantly.

**Vermont Farm Methane Project Case Study:** MJ Bradley Associates from Concord, MA has written a case study of the Vermont Methane Project for the Clean Air - Cool Planet Alliance. This alliance is working to reduce green house gas emissions by building broad-based partnerships between towns, corporations, schools, hospitals, universities, citizen groups, faith-based institutions, individuals and other organizations in the Northeast. The Vermont Methane Project has cooperated with the authors of this case study and hopes to be able to use the results to educate other potential partners in the region.

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Attachments:

Foster Bros. Digester Observations, a report from Bob and Jim Foster on their recent observations.

*Wind and Biomass Integration Scenarios in Vermont*, a description of a study being conducted by Princeton Energy Research International.

*The State of Vermont Farm Methane Recovery Project* a case study prepared by Geoffrey Keith of M.J. Bradley & Associates for Clean Air/ Cool Planet a public/private alliance of organizations that aims to bring about actual greenhouse gas emission reductions as soon as possible.

*Clean Air / Cool Planet A Northeast Alliance*, Concept and Organization Description.